PATENT COOPERATION T[illegible]AT[illegible]

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

KUSMER, Toby
McDERMOTT, WILL & EMERY
28 State Street
Boston, MA 02109-1775
ETATS-UNIS D'AMERIQUE

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NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL PRELIMINARY EXAMINATION REPORT
(PCT Rule 71.1)

Date of mailing *(day/month/year)*	09.10.2000
Applicant's or agent's file reference 52969-021	**IMPORTANT NOTIFICATION**

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US99/24732	25/10/1999	15/12/1998

Applicant
PRAGMATIC VISION, INC. et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. **REMINDER**

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/	Authorized officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Ghellere, M Tel.+49 89 2399-2053

Form PCT/IPEA/416 (July 1992)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

15

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
52969-021		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US99/24732	25/10/1999	15/12/1998
International Patent Classification (IPC) or national classification and IPC D21F9/00		
Applicant PRAGMATIC VISION, INC. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

NPL

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
07/04/2000	09.10.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Maisonnier, C Telephone No. +49 89 2399 2064

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US99/24732

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-14 as originally filed

Claims, No.:

1-10 as originally filed

Drawings, sheets:

1/1 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-10
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-10
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-10
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V (Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement)

The closest prior art is known from US-A-3 949 035 cited by the applicant in the description which discloses an aerodynamic method of making tissue paper as well as an apparatus for carrying out the method.

According to US-A-3 949 035, an aerosuspension of fibrous material is prepared and deposited on a forming wire to form a layer of fibres. The layer of fibres is moistened on the forming wire by spraying water on the fibrous layer while applying suction through the forming wire. The fibrous layer is subsequently transferred to a pressing means comprising two rolls, one of which is heated and has a pressing surface comprising protruding elements, prior to being transferred to a drying means.

The problem to be solved by the current invention is to provide tissue paper bonded by formation of hydrogen bonds manufactured at low cost.

This is solved according to Claims 1, 6 and 10 by pressing a layer of fibres formed from an aerosuspension of fibres between a profiling belt and a moistening belt, the profiling belt having a pressing surface with protruding elements for impressing first areas of the fibrous layer and the moistening belt having a lower sorption capacity than the sorption capacity of the first areas of the fibrous layer being impressed by the protruding elements and higher then the sorption capacity of second areas of the fibrous layer that are not impressed by the protruding elements.

Thus, the present invention provides concurrent moistening and pressing of the fibrous layer, the moistening belt providing a selective moistening of the fibrous layer which minimizes the amount of water applied to the fibrous layer and thereby reduces time and energy required for subsequent drying of the fibrous layer.

There is no indication leading in this direction in any of the documents cited:
- Although GB-A-1 439 966 addresses the problem of avoiding extensive drying of

an air laid web for tissue and towelling applications, the problem is solved by manufacturing an adhesively bonded web.
- WO-A-85/03962 relates to a method of manufacturing a dry laid fibre web for use as kitchen roll paper which is embossed using an embosser roller prior to being glued.

Thus, the subject-matter of Claims 1, 6 and 10 is novel and involves an inventive step with respect to the cited prior art.

Dependent Claims 2 to 5 and 7 to 9 define additional features of the method according to Claim 1 and of the apparatus according to Claim 6, and, thus, also relate to novel and inventive subject-matter.

The possibility of industrial application is obvious.

Re Item VII (Certain defects in the international application)

1. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

2. US patent No. 3 908 653 cited on page 2 of the description is not correct, since this patent relates to a blood chamber for an arterial line of an extracorporeal blood system rather than to high-absorbency products as stated in the description. It appears that the correct number should be 3 908 659.

Re Item VIII (Certain observations on the international application)

Although Claims 1 and 10 have been drafted as separate independent claims, they relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims

makes it difficult to determine the matter for which protection is sought and places an undue burden on others seeking to establish the extent of the protection. Hence, Claims 1 and 10 do not meet the requirements of Article 6 PCT.

PCT

REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference *(if desired) (12 characters maximum)* 52969-021

Box No. I TITLE OF INVENTION

AERODYNAMIC METHOD FOR MAKING TISSUE PAPER

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

PRAGMATIC VISION, INC.
225 Friend Street
Boston, MA 02114
US

☐ This person is also inventor.

Telephone No.

Facsimile No.

Teleprinter No.

State *(that is, country)* of nationality: US

State *(that is, country)* of residence: US

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

BROBOSYUK., Viktor Mikhailovich
F. Portnovoy, 17,1,108
St. Petersburg
Russian Federation 198207
RU

This person is:

☐ applicant only

☒ applicant and inventor

☐ inventor only *(If this check-box is marked, do not fill in below.)*

State *(that is, country)* of nationality: RU

State *(that is, country)* of residence: RU

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)*

THENOR, Leonid D.
McDERMOTT, WILL & EMERY
600 13th Street, N.W.
Washington, D.C. 20005-3096
US

Telephone No.
202-756-8000

Facsimile No.
202-756-8087

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

Box No.V DESIGNATIO[redacted]TATES

The following designations are hereby made under Rule 4.9(a) *(mark the applicable check-boxes; at least one must be marked):*

Regional Patent

☒ **AP ARIPO Patent:** **GH** Ghana, **GM** Gambia, **KE** Kenya, **LS** Lesotho, **MW** Malawi, **SD** Sudan, **SL** Sierra Leone, **SZ** Swaziland, **UG** Uganda, **ZW** Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT

☒ **EA Eurasian Patent:** **AM** Armenia, **AZ** Azerbaijan, **BY** Belarus, **KG** Kyrgyzstan, **KZ** Kazakhstan, **MD** Republic of Moldova, **RU** Russian Federation, **TJ** Tajikistan, **TM** Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT

☒ **EP European Patent:** **AT** Austria, **BE** Belgium, **CH and LI** Switzerland and Liechtenstein, **CY** Cyprus, **DE** Germany, **DK** Denmark, **ES** Spain, **FI** Finland, **FR** France, **GB** United Kingdom, **GR** Greece, **IE** Ireland, **IT** Italy, **LU** Luxembourg, **MC** Monaco, **NL** Netherlands, **PT** Portugal, **SE** Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT

☒ **OA OAPI Patent:** **BF** Burkina Faso, **BJ** Benin, **CF** Central African Republic, **CG** Congo, **CI** Cote d'Ivoire, **CM** Cameroon, **GA** Gabon, **GN** Guinea, **GW** Guinea-Bissau, **ML** Mali, **MR** Mauritania, **NE** Niger, **SN** Senegal, **TD** Chad, **TG** Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)* .....

National Patent *(if other kind of protection or treatment desired, specify on dotted line):*

☒ **AE** United Arab Emirates
☒ **AL** Albania .....
☒ **AM** Armenia .....
☒ **AT** Austria .....
☒ **AU** Australia .....
☒ **AZ** Azerbaijan
☒ **BA** Bosnia and Herzegovina .....
☒ **BB** Barbados
☒ **BG** Bulgaria .....
☒ **BR** Brazil .....
☒ **BY** Belarus .....
☒ **CA** Canada
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☒ **DE** Germany .....
☒ **DK** Denmark .....
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☒ **HU** Hungary .....
☒ **ID** Indonesia
☒ **IL** Israel .....
☒ **IN** India .....
☒ **IS** Iceland
☒ **JP** Japan .....
☒ **KE** Kenya .....
☒ **KG** Kyrgyzstan .....
☒ **KP** Democratic People's Republic of Korea .....
.....
☒ **KR** Republic of Korea .....
☒ **KZ** Kazakhstan .....
☒ **LC** Saint Lucia
☒ **LK** Sri Lanka
☒ **LR** Liberia
☒ **LS** Lesotho .....
☒ **LT** Lithuania
☒ **LU** Luxembourg
☒ **LV** Latvia
☒ **MD** Republic of Moldova .....
☒ **MG** Madagascar .....
☒ **MK** The former Yugoslav Republic of Macedonia .....
.....
☒ **MN** Mongolia
☒ **MW** Malawi .....
☒ **MX** Mexico .....
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☒ **PL** Poland .....
☒ **PT** Portugal .....
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☒ **TR** Turkey .....
☒ **TT** Trinidad and Tobago .....
☒ **UA** Ukraine .....
☒ **UG** Uganda .....
☒ **US** United States of America .....
.....
☒ **UZ** Uzbekistan .....
☒ **VN** Viet Nam .....
☒ **YU** Yugoslavia .....
☒ **ZA** South Africa .....
☒ **ZW** Zimbabwe .....

Check-boxes reserved for designating States which have become party to the PCT after issuance of this sheet:

☒ MA.Morocco .....
☐ .....

Precautionary Designation Statement: In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and by the applicant at the expiration of that time limit. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Supplemental Box *If the Supplemental Box is not used, this sheet need not be included in the request.*

*1. If, in any of the Boxes, **the space is insufficient** to furnish all the information: in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:*

*(i) **if more than two persons are involved as applicants and/or inventors** and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;*

*(ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication **"the States indicated in the Supplemental Box"** is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;*

*(iii) if, in Box No. II or in any of the sub-boxes of Box No. III, **the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America:** in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;*

*(iv) if, in addition to the agent(s) indicated in Box IV, there are **further agents**: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;*

*(v) if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication **"patent of addition,"** or **"certificate of addition,"** or if, in Box No. V., the name of the United States of America is accompanied by an indication **"continuation"** or **"continuation-in-part"**: in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI) , the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;*

*(vi) if, in Box No. VI, there are **more than three earlier applications whose priority is claimed:** in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI;*

*(vii) if, in Box No. VI, the **earlier application is an ARIPO application:** in such case, write "Continuation of Box No. VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed.*

*2. If, with regard to the **precautionary designation statement** contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.*

*3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning **non-prejudicial disclosures or exceptions to lack of novelty**: in such case, write "Statement concerning non-prejudical disclosures or exceptions to lack of novelty" and furnish that statement below.*

Edward A. Becker, Reg. No. 37,777; Stephen A. Becker, Reg. No. 26,527; Marcel K. Bingham, Reg. No. 42,327; John G. Bisbikis, Reg. No. 37,095; Daniel Bucca, Reg. No. 42,368; Kenneth L. Cage, Reg. No. 26,151; Stephen C. Carlson, Reg. No. 39,929; Tom A. Corrado, Reg. No. 42,439; Paul Devinsky, Reg. No. 28,553; Margaret M. Duncan, Reg. No. 30,879; Brian E. Ferguson, Reg. No. 36,801; Michael F. Fogarty, Reg. No. 36,139; Willem F. Gadiano, Reg. No. 37,136; Keith E. George, Reg. No. 34,111; John A. Hankins, Reg. No. 32,029; Brian D. Hickman, Reg. No. 35,894; Eric J. Kraus, Reg. No. 36,190; Patrick B. Law, Reg. No. 41,549; Robert E. LeBlanc, Reg. No. 17,219; Jack Q. Lever, Reg. No. 28 ,149; Raphael V. Lupo, Reg. No. 28,363; Christine F. Martin, Reg. No. 39.762; Michael A. Messina, Reg. No. 33,424; Eugene J. Molinelli, Reg. No. 42,901; Christopher J. Palermo, Reg. No. 42,056; Joseph H. Paquin, Jr., Reg. No. 31,647; Robert L. Price, Reg. No. 22,685; Gene Z. Rubinson, Reg. No. 33,351; Joy Ann G. Serauskas, Reg. No. 27,952; David A. Spenard, Reg. No. 37,449; Arthur J. Steiner, Reg. No. 26,106; David L. Stewart, Reg. No. 37,578; Michael D. Switzer, Reg. No. 39,552; Leonid D. Thenor, Reg. No. 39,397; Keith J. Townsend, Reg. No. 40,358; Leon R. Turkevich, Reg. No. 34,035; Aaron Weisstuch, Reg. No. P41,557; Edward J. Wise, Reg. No. 34,523; Alexander V. Yampolsky, Reg. No. 36,324; and Robert W. Zelnick, Reg. No. 36,976

Box No. VI PRIORITY ☐ Further prior … re indicated in the Supplemental Box.

Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is: national application: country	regional application:* regional Office	international application: receiving Office
item (1) 15 December 1998 15/12/98	98122569	RU		
item (2)				
item (3)				

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): _____

** Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):*

ISA/ EP

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number Country (or regional Office)

Box No. VIII CHECK LIST: LANGUAGE OF FILING

This international application contains the following **number of sheets:**

request	:	4
description (excluding) sequence listing part)	:	14
claims	:	5
abstract	:	1
drawings	:	1
sequence listing part of description	:	
Total number of sheets	:	25

This international application is **accompanied** by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☐ copy of general power of attorney; reference number, if any:
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as items(s):
6. ☐ translation of international application into (language):
7. ☐ separate indications concerning deposited microorganism or other biological material
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify):*

Figure of the drawings which should accompany the abstract: 1

Language of filing of the international application: English

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

Leonid D. THENOR

For receiving Office use only

1. Date of actual receipt of the purported international application:
2. Drawings: ☐ received: ☐ not received:
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority (if two or more are competent): ISA/
6. ☐ Transmittal of search copy delayed until search fee is paid

For International Bureau use only

Date of receipt of the record copy by the International Bureau:

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Assistant Commissioner for Patents
United States Patent and Trademark Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 28 June 2000 (28.06.00)	
International application No. PCT/US99/24732	**Applicant's or agent's file reference** 52969-021
International filing date (day/month/year) 25 October 1999 (25.10.99)	**Priority date** (day/month/year) 15 December 1998 (15.12.98)
Applicant DROBOSYUK, Viktor Mikhailovich	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

07 April 2000 (07.04.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer A. Karkachi
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

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WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : D21F

A2

(11) International Publication Number: WO 00/36212

(43) International Publication Date: 22 June 2000 (22.06.00)

(21) International Application Number: PCT/US99/24732

(22) International Filing Date: 25 October 1999 (25.10.99)

(30) Priority Data:
98122569 15 December 1998 (15.12.98) RU

(71) Applicant *(for all designated States except US)*: PRAGMATIC VISION, INC. [US/US]; 225 Friend Street, Boston, MA 02114 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: DROBOSYUK, Viktor Mikhailovich [RU/RU]; F. Portnovoy, 17,1,108, St. Petersburg 198207 (RU).

(74) Agents: THENOR, Leonid, D. et al.; McDermott, Will & Emery, 600 13th Street, N.W., Washington, DC 20005–3096 (US).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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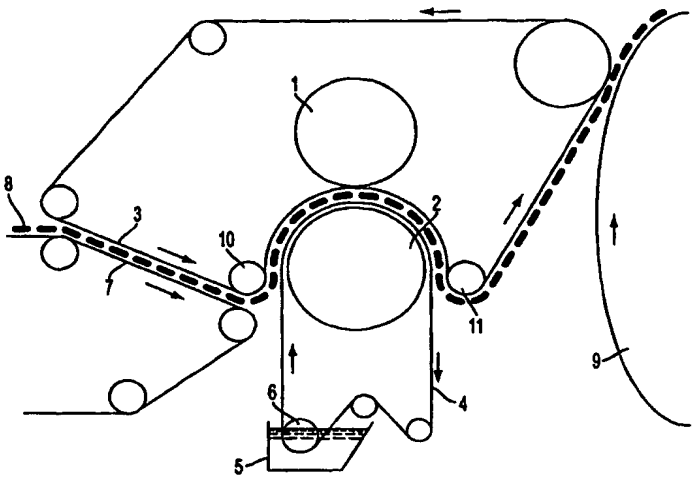

(57) Abstract

An aerodynamic method of making tissue paper comprises the steps of preparing an aerosuspension out of cellulose fibers, forming a layer of fibers on a forming wire, moistening the formed layer of fibers and pressing and drying of said formed layer. The step of moistening the layer of fibers is performed concurrently with the step of pressing, for which purpose the layer of fibers is placed between the profiling and moistening belts. The surface of the profiling belt comprises protruding elements, wherein a distance between two mutually–adjacent protruding elements doesn't exceed an average length of the fibers. A wire with smoothed nodes of interweaving threads can be used as the profiling belt, while fine–mesh wire can be used as a moistening belt. Selective moistening of fibers only in the areas being pressed eliminates moistening of the entire layer, and drying of the paper web requires significantly less expenditures of time and energy. Shrinkage of the paper web is also minimized because the non–pressed areas of fibrous layer don't practically get moistened.

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AERODYNAMIC METHOD FOR MAKING TISSUE PAPER

FIELD OF THE INVENTION

The present invention relates to the field of papermaking, and more particularly, to a method of manufacturing tissue paper featuring enhanced absorbency.

BACKGROUND OF THE INVENTION

One of the main problems that one encounters when making tissue paper by an aerodynamic method without using binders is the ability to provide a tissue paper having both a high absorbency (hygroscopicity) and sufficient strength. This is so because when the aerodynamic method is used without binders, the bonding of fibers is obtained from hydrogen bonds formed as a result of pressure processing and subsequent drying of the moistened layer of fibers produced from aerosuspension. Pressing of the fibrous layer is necessary to provide a greater area of inter-fibrous contact, while a drying is required to remove water molecules and form the above-mentioned hydrogen bonds between the fibers. Thus, the greater the pressure, the stronger the tissue produced and the lower its absorbency, and vice versa.

One conventional aerodynamic method of paper making comprises forming of a layer of cellulose fibers out of aerosuspension, impregnating

this layer by a liquid reagent, and subsequently pressing and drying of this layer. See, for example, USSR Author's Certificate 1594237, IPC 5 D21H 23/00, 21/18, published August 23, 1990. This method is characterized by the use of 2 - 8% water solution of resorcin that provides much better swelling of fibers than water. Penetration of water into intercrystalline space of pulp fibers facilitates enhancement of their plasticity, which results in more complete contact of fibers during pressing and drying, and, hence, enhances the strength of fiber bonding. Since molecules of resorcin form bonds of a "cellulose-resorcin-cellulose" type, resorcin also performs the function of a binder, which also facilitates the enhancement of the produced tissue strength. Thus, when using a water/resorcin solution for moistening the fibrous layer, one can decrease the pressure applied at the stage of pressing, thereby improving tissue absorbency while preserving tissue strength. However, introduction of chemical additives makes tissue paper production more expensive.

Another conventional method for making high-absorbency products out of fibrous materials comprises forming of a multi-layer structure of thin paper layers and a layer of fibers produced out of aerosuspension and placed between paper layers. All the layers arranged in the above manner are pressed between rolls, one of which has a patterned surface. See, for example, USA patent 3908653, IPC 2 A61F 13/16, A61L 15/00, published September 30, 1975. Final formation of the product proceeds in the

following manner: two structures obtained in the above-described way are folded together facing each other with patterned surfaces and then the edges are jet-molded or glued together. Since the filler in the product comprises substantially non-pressed fibers, the final product offers high hygroscopicity, but the manufacturing cost of such products is very high.

One conventional aerodynamic method of papermaking, which is believed to be the closest to the present invention, comprises preparation of aerosuspension of cellulose fibers, forming a fibrous layer on a moving forming wire, moistening the moving fibrous layer with water, the amount of which constitutes 20 - 60 % of fiber weight, and subsequently pressing and drying of said fibrous layer. See, for example, USA patent 3949035, IPC 2 B29C 17/04, published April 6, 1976 - prototype. Pressing is performed between two rotating rolls, one of which has a patterned surface made in the form of ridges with flat faces of round (or circular) shape, and the distance between ridges doesn't exceed the average length of the cellulose fibers. During pressing, compaction of the fibrous layer and formation of greater contact area between the fibers take place in the ridge areas, while no compaction occurs in the areas between the ridges (i. e., in valleys). As a result, the final product obtained after drying has two types of areas: areas of a pressed fibrous layer that determine the strength of the tissue paper, and areas of non-pressed fibrous layer that determine tissue

absorbency. Thus, this method enables one to produce tissue paper, the structure of which concurrently provides tissue strength and hygroscopicity.

At the same time, to provide the formation of the above-mentioned inter-fibrous bonds, the formed fibrous layer should be moistened with a substantial amount of water. Besides, to provide better penetration of water into the fibrous layer, this moistening is accompanied by rarefaction of air produced underneath the wire carrying the fibrous layer. Such a moistening process requires amounts of water that are excessive compared to the amounts needed for the formation of inter-fibrous bonds. In addition, it takes an extra time to moisten the entire fibrous layer. All the above results in extra expenditures of energy (mainly expended on subsequent drying of the tissue paper web) and slows down the process of tissue production. Besides, removal of great amounts of water through drying leads to the shrinkage of the non-pressed part of the fibrous layer, which results in a decrease in absorbency of the produced tissue paper.

SUMMARY OF THE INVENTION

The present invention advantageously decreases the costs related to the manufacture of tissue paper and increases of the quality of the tissue paper.

According to an embodiment of the present invention, a method of making tissue paper comprises the following steps: preparing an

aerosuspension of fibrous material; forming a layer of fibers on a forming wire; transferring the layer of fibers to a profiling belt having a pressing surface containing protruding elements for impressing first areas of the fibrous layer in contact therewith; contacting the layer of fibers disposed on the pressing surface of the profiling belt with a moistening belt; and pressing the layer of fibers between the profiling belt and the moistening belt. In addition, the moistening belt has a lower sorption capacity than a sorption capacity of the first areas of the fibrous layer being impressed by the protruding elements and higher than a sorption capacity than second areas of the fibrous layer that are not impressed by the protruding elements.

According to the present invention, a distance between protruding relief elements on the pressing surface does not exceed an average length of the fibers. The formed layer of fibers can be placed on a profiling belt that has a pressing surface that faces the layer of fibers. Moistening of the formed layer of fibers is performed concurrently with the pressing step, an utilizes an additional belt such as, for example, a moistening belt. The moistening belt is disposed such that a pressing force is exerted concurrently on the profiling belt, the moistening belt, and the layer of fibers located therebetween. The moistening belt is preferably made of a material having a sorption capacity that is lower than a sorption capacity of those areas of the layer of fibers that are pressed due to the protruding

relief elements, but higher than the sorption capacity of the areas of the layer of fibers that are not pressed by the relief elements. The moistening belt can be saturated with an appropriate fluid such as, for example, water, in an area that is outside the pressing zone.

In one embodiment of the claimed invention, the fibrous layer placed between the profiling and moistening belts during the step of pressing. In the course of pressing, the sections of fibrous layer that are in the areas of protruding relief elements get compacted, which results in an increase of absorbency of the fibrous layer, due to the increase in the pressure of capillary absorption. When the fibrous layer absorbency reaches a value equal to the value of the same parameter of the moistening belt, the sections of the fibrous layer being compacted begin to absorb water from the moistening belt surface. With further compaction of the fibrous layer the excess water is squeezed out from the compacted sections into the non-compacted sections, and due to the difference in capillary absorption pressures, this water returns to the moistening belt. Part of the water returned will subsequently be absorbed by new sections of the layer of fibers being compacted. The moistening belt receives water required for moistening outside the pressing zone, for example, absorbing it when being passed through a tub with water.

The present invention provides concurrent moistening and pressing of the fibrous layer in order to minimize the amount of water required at the

pressing stage. Selective moistening of fibers only in the sections being compacted eliminates the requirement for moistening the entire fibrous layer, and excessive moistening. As a consequence, drying of the tissue paper web after the pressing step requires significantly lower expenditures of time and energy. Additionally, shrinkage of the tissue paper web is eliminated because the non-pressed sections of the fibrous layer are not moistened.

A wire made by means of interweaving threads can be used as the profiling belt. In this instance interweaving nodes represent the protruding relief elements of wire surface, and the shape of flat areas can be endowed through the use of smoothing. This approach can significantly reduces the cost of the process of the present invention.

Another simple and inexpensive embodiment of a moistening belt comprises a fine-mesh wire. In this instance sorption properties of the moistening belt are determined by surface properties of the material of the wire, as well as by relative sizes and geometrical configurations of threads and openings of the wire.

Further, longitudinal twisting of fibers that significantly decreases the area of contact between fibers in the areas pressed can be prevented if the prepared aerosuspension has a moisture content sufficient for causing saturation of fibers' walls with moisture.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a process diagram illustrating the process of moistening and pressing of a fibrous layer according to an embodiment of the present invention.

Fig.2 is a top plan view illustrating a profiling belt made in the form of wire, having smoothed surfaces of nodes produced by intersections of threads.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 1, a pressing unit of a paper-making machine that uses the method of the present invention comprises a roller press having two pressure rollers 1 and 2, a profiling belt 3, a moistening belt 4, and a tub 5 with water into which a drum 6 is submerged. The drum 6 is intended for transporting the moistening belt 4 through the tub 5. Fig. 1 also shows a forming wire 7 on which fibrous layer 8 is formed, a drying drum 9, and wire-driving rollers and take-up suction rolls 10 and 11.

The profiling belt 3, a fragment of which is shown in Fig. 2, can be made out of wire comprising interweaving threads 12 and wefts 13 of round (circular) cross-section. The nodes of this wire on the side contacting the fibrous layer are smoothed to such an extent that flat pressing surfaces 14 of elliptic shape are produced, and said flat pressing surfaces 14 determine the fibrous layer sections to be pressed. Geometric size of the wire and

the surfaces 14 are selected so that a distance between the surfaces 14 of juxtaposed nodes of the wire doesn't exceed an average length of the fibers. The strongest paper retaining good absorbing properties can be produced when this distance is approximately equal to half of the average length of the fibers. In this instance the individual fibers interconnect with each other and transmit mechanical stresses arising in the conditions of paper break from one pressed area to another.

Fibrous layer 8 formed out of aerosuspension (forming process is not shown in Fig.1) through the use of the forming wire 7 and the profiling belt 3 is supplied to a zone of the suction roll 10 where the forming wire 7 breaks away, and the side of the fibrous layer 8 that has just lost contact with the forming wire is covered by the moistening belt 4. Such a forming belt can be made, for instance, in the form of a fine-mesh wire. The fibrous layer 8, now positioned between the profiling belt 3 and the moistening belt 4, is then fed to a pressing operation between rolls 1 and 2. Pressing of the fibrous layer 8 proceeds as described in the Summary of the Invention above. Subsequent to pressing, the belt 4 breaks away in the area of a take-up suction roll 11, and the pressed fibrous layer is fed to the drying drum 9, from which the finished paper web is subsequently obtained.

The possibility of implementing the claimed method was experimentally tested in a following manner.

Samples of tissue paper with specific weight of 40 - 45 g/m^3 were produced. Softwood and hardwood sulfate bleached pulp (with the average length of fibers 2.7mm and 1.4 mm, respectively) were used as fibrous semi-finished material.

An aerosuspension of fibers was prepared out of fibrous semi-finished material that has been moistened in advance to a moisture content of 50%. This aerosuspension was fed to the forming wire where a fibrous layer having a specific weight of 15 - 20 kg/m^3 was formed. A wire of interwoven synthetic threads 0.25mm in diameter and with the distance of 0.25 mm between core threads and 0.3 mm between weft threads was used as forming wire.

The formed fibrous layer (the moisture content of which was 30 - 35% at this technological stage) was transported to the profiling belt represented by standard metal wires #1 or #2 of simple interweaving generally used in papermaking industry. Wire #1 is woven out of flat threads, and the shape of its meshes is square. There are eight threads per 1 cm of running length, thread width is equal to 0.6 mm; thread thickness = 0.15 mm; distance between threads = 0.65 mm, and the area of threads constitutes 70% of the total wire area.

Wire #2 is woven out of threads of round section and of diameter 0.5 mm, and the shape of its meshes square. There are eight threads per 1

cm of running length, and the distance between threads is 0.75 mm. One surface of wire #2 was smoothed up to a depth of 0.25mm. Flat areas of elliptical shape, the total area of which constitutes 40% of the total wire area, were produced as a result of the smoothing. The fibrous layer was placed on the smoothed wire surface at the pressing stage.

Two fine-mesh wires joined together were used as a moistening belt. Each fine-mesh wire is made by simple interweaving of threads 0.25 mm in diameter, and there are 24 threads per 1 cm of running length. Moisture capacity defined as the amount of water retained by capillary forces in the wire of area 1 m^2 constitutes 0.08 kg/m^2.

The formed fibrous layer placed between the profiling wire (#1 or #2) and moistening wires was fed into the gap between the rolls of a roller press developing a force of 10 or 18 kg on 1cm of layer width. Subsequent to pressing, the moistening wires were taken off the fibrous layer, while the layer being held by profiling wire was fed to drying unit, the surface of which was heated to the temperature of 115 C.

Results of experimental testing are given in the Table below.

	Specific gravity of the layer of fibers, kg/m³	Moisture content of fibers on the forming wire, %	of profiling wire	Pressing force, kg	Moisture content of fibers after pressing, %	Tensile strength of paper sample, N/m	Moisture capacity of paper sample, kg of water per kg of absolutely dry fibers
1	0.04	35	1	10	52	600	2.2
2	0.045	35	1	10	54	550	2.1
3	0.04	30	1	18	43	850	1.9
4	0.04	32	1	18	45	870	1.9
5	0.04	35	1	18	47	960	1.9
6	0.045	30	1	18	45	840	1.8
7	0.045	35	1	18	48	850	1.8
8	0.04	30	2	10	48	550	2.3
9	0.04	35	2	10	51	550	2.2
10	0.045	30	2	10	49	620	1.8
11	0.045	35	2	10	50	640	1.9
12	0.04	30	2	18	48	670	2.2
13	0.04	35	2	18	51	700	2.1

The experiments performed confirm the possibility of implementing the method of the present invention and verified the above-indicated results. Using this method, it is possible to make tissue paper offering such strength and hygroscopic properties that correspond to the current specifications for tissue paper making. It should be pointed out that the amounts of water expended with this method are significantly less compared to the amounts spent when using other known methods. It can

be seen from the above Table that moisture content of the fibrous layer fed to drying subsequent to pressing varies only slightly compared to the moisture content of fibrous layer on the forming wire, which significantly reduces the cost of drying and decreases the shrinkage of paper web during drying.

Results of the experiments also indicate how parameters of technological process and equipment units exert influence on the final result. For example, when using wire #1 which is made out of flat threads and which has "shallow" relief formed by the interwoven nodes of threads, greater pressure should be applied to obtain required strength properties of the final product.

On the other hand, to obtain a required strength of tissue paper, quite high pressure is also needed when using wire #2 that is made of round threads and that has lesser area of pressing zones compared to wire #1. However, it is just the lesser area of pressing zones that makes it possible to obtain tissue paper offering greater absorbency than the tissue paper produced using wire #1.

Results of experiments given in the above Table in the 3rd, 4th, and 5th lines confirm that initial moisture content of a fibrous layer fed to a pressing operation also exerts impact on the strength of tissue paper being manufactured. The greater the moisture content of the fibers, the softer

and less twisted are they. Therefore, the contact area of such fibers is greater in the course of pressing. This fact results in the formation of inter-fibrous bonds on greater area, and, hence, in stronger tissue paper, while absorbency of such tissue paper remains the same.

While this invention has been described in connection with what is presently considered to be the most practical and preferred embodiments, it is to be understood that the invention is not limited to the disclosed embodiments, but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. An aerodynamic method of making tissue paper comprising the steps:

(a) preparing an aerosuspension of fibrous material;

(b) forming a layer of fibers on a forming wire;

(c) transferring the layer of fibers to a profiling belt having a pressing surface containing protruding elements for impressing first areas of the fibrous layer in contact therewith;

(d) contacting the layer of fibers disposed on the pressing surface of the profiling belt with a moistening belt; and

(e) pressing the layer of fibers between the profiling belt and the moistening belt;

wherein the moistening belt has a lower sorption capacity than a sorption capacity of the first areas of the fibrous layer being impressed by the protruding elements and higher than a sorption capacity of second areas of the fibrous layer that are not impressed by the protruding elements.

2. The method of Claim 1, wherein the step of transferring comprises a step of transferring the layer of fibers to a profiling belt having a pressing surface containing protruding elements for impressing first areas of the fibrous layer in contact therewith, and a distance between

mutually-adjacent protruding elements is not greater than an average length of individual fibers of the layer of fibers.

3. The method of claim 1, wherein the step of transferring is performed using a profiling belt that comprises a wire made of threads interwoven such that nodes formed by said interwoven threads form the protruding elements of the pressing surface, and the protruding elements having relatively flat surface areas contacting the layer of fibers.

4. The method of claim 1, wherein the step of contacting comprises a step of contacting the layer of fibers disposed on the pressing surface of the profiling belt with a moistening wire.

5. The method of claim 1, wherein the step preparing an aerosuspension comprises a step of preparing an aerosuspension of fibrous material having a moisture content that provides saturation of walls of the fibers.

6. An apparatus for making tissue paper by an aerodynamic method, the apparatus comprising:

a forming wire for receiving an aerosuspension of fibers and forming a layer of fibers thereon;

a profiling belt having a pressing surface comprising protruding elements configured and arranged for contacting first areas of said layer of fibers, thereby impressing the first areas of said layer of fibers;

a moistening belt comprising a material having a sorption capacity lower than a sorption capacity of the first areas of said layer of fibers, and higher than a sorption capacity of second areas of said layer of fibers that are not contacted by said protruding elements; and

a pressing assembly for impressing the layer of fibers between the profiling belt and the moistening belt.

7. The apparatus of claim 6, wherein said pressing assembly comprises a pair of pressure rollers for exherting a force on the layer of fibers, the profiling belt, and the moistening belt.

8. The apparatus of claim 6, wherein a distance between mutually-adjacent protruding elements of the pressing surface of said profiling belt is not greater than an average length of individual fibers of the layer of fibers.

9. The apparatus of claim 6, wherein the protruding elements of said pressing surface have elliptical profiles.

10. An aerodynamic method for tissue paper making comprising the steps: preparing an of aerosuspension out of cellulose fibers or other fibrous material, forming of a layer of fibers on a moving forming wire;

moistening the formed layer of fibers; and

and pressing and drying said formed layer;,

wherein the pressing is performed by a pressing means having a pressing surface, for contacting with said layer of fibers, which is made as a relief surface and the distance between the protruding relief elements on the pressing surface doesn't exceed the average length of fibers; and,

wherein the method is distinguished by the fact that during pressing, the formed layer of fibers is placed on an additional profiling felt, the surface of which facing said layer of fibers represents said pressing surface, and moistening of the formed layer of fibers is performed concurrently with pressing for which purpose an additional moistening felt is used, and said moistening felt is accommodated in such a way

that pressing action is exerted concurrently on profiling and moistening felts and on the layer of fibers located between said felts, and such a material is used as a moistening felt the sorption capacity of which is lower than sorption capacity of those areas of said layer of fibers that are pressed due to the protruding relief elements, and at the same time the sorption capacity of said material is higher than the areas of said layer of fibers that are non-pressed by said relief elements, and saturation of moistening felt with water is performed outside the pressing zone.

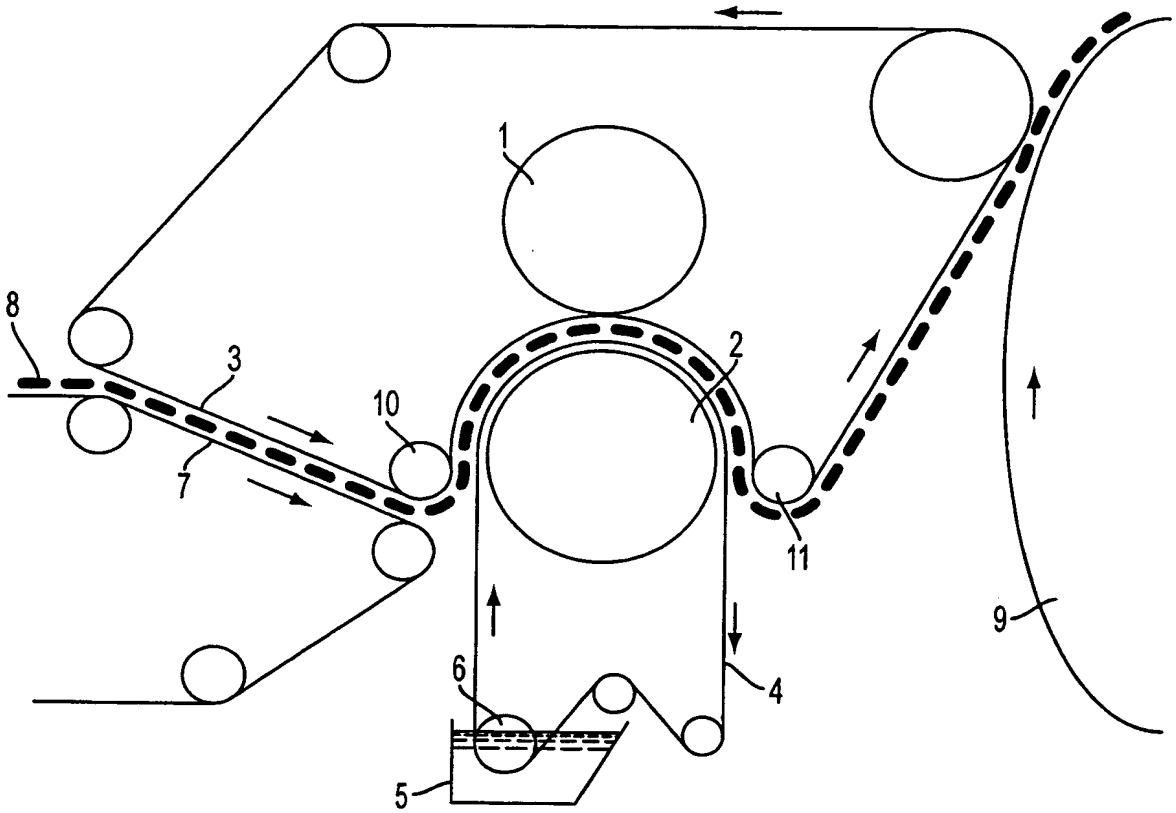

FIG. 1

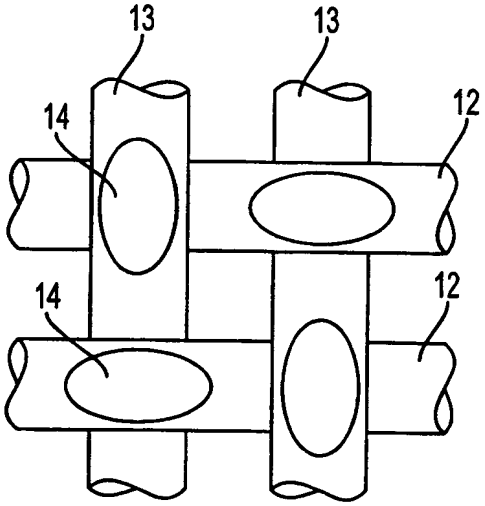

FIG. 2